INDOOR AIR QUALITY ASSESSMENT

Hopedale Town Hall
Main Street
Hopedale, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

Based on a request from Leonard Izzo, Health Agent of the Hopedale Board of Health, an indoor air quality assessment was done at the Hopedale Town Hall, Main Street, Hopedale, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). Mr. Izzo reported that building staff had experienced eye and throat irritations. On March 30, 2000, a visit was made to this building by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ). Mr. Feeney was accompanied by Mr. Izzo during part of the assessment.

The Hopedale Town Hall is a two-story, brownstone, wood frame structure built in 1886. The building underwent renovations in 1970. The building has four full floors. The attic is used for storage. The second floor contains an auditorium and three offices. The backstage area is used as an office by the local cable television station. The first floor contains several town offices and a small meeting room. In addition to town offices, a privately run, one room restaurant exists on the first floor of the building. The basement contains several town offices, including the board of health, building inspector and water department. The windows in this building are openable.

Methods

Air tests for carbon dioxide were taken with the Telaire Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with the Mannix, ThPen PTH8708 Hygrometer/Thermometer.

Results

These offices have an employee population of approximately 15. The tests were taken under normal operating conditions. Test results appear in Table 1. Air sampling results are listed by floor. Since the individual offices and cubicles are not numbered, the program area, function or name of the occupant denotes the location of where the sample was taken.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were below 800 parts per million of air (ppm) in all areas sampled in this building, which is indicative of an adequate air supply in the building. The building appears to be originally designed to use openable windows for ventilation. Renovations added mechanical ventilation systems to selected areas in the building. The general office contains a heat pump that is located above the suspended ceiling. Fresh air is drawn by this system through a vent in the east wall of the building (see Picture 1). Air is distributed by ductwork to ceiling mounted air diffusers. Air from the room is drawn through a plastic grate in the ceiling below the heat pump (see Picture 2). This heat pump system was operating during this assessment. The restaurant has a separate ventilation system that was also operating during the assessment.

The auditorium does not have a mechanical fresh air supply. Several passive vents around light fixtures are located in the ceiling (see Pictures 3 and 4). Several trap doors exist in the floor of the attic. When these trap doors are opened, the passive vents are opened. A mechanical exhaust vent appears to be retrofitted over one of the light fixture vents (see Pictures 5 and 6). This mechanical exhaust vent could not be activated during the assessment.

The remainder of the building, except for offices in the basement, relies on openable windows to provide fresh air. Offices in the basement do not have openable exterior windows.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The date of the last servicing and balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997, BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 69^{o} F to 80^{o} F, which is slightly over the BEHA recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The general offices serviced by the heat pump had the highest temperature readings of all areas sampled (80^{o} F). This increased temperature is likely the result of several factors. First, heat produced by office equipment (e.g., computers, photocopiers, etc.) can influence temperature control. Second, the HVAC system is controlled by a thermostat. These thermostats have three settings: on, off and automatic. The automatic setting on the thermostat activates the HVAC system at a preset temperature. Once a preset temperature is reached in the area of the thermostat, the HVAC system is deactivated. Without the HVAC system functioning, excess heat produced by office equipment can build up.

The relative humidity in the building ranged from 11 to 25 percent, which is below the BEHA recommended comfort range in all areas sampled. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A number of interior areas in the building have signs of water damaged wall plaster (see Picture 7). The source of water damaged plaster appears to be water penetration through either wooden window frames (see Picture 8), or seams of exterior wall brick (see Picture 9). Water damaged wall plaster can serve as a mold growth medium, especially if wetted repeatedly.

The Board of Selectmen's' office contains a fireplace that is sealed (see Picture 10). The face of the ironwork within the fireplace is coated with a dried powdery material (see Picture 11). The attic floor at the base of the chimney above this fireplace is coated with powdered brick and mortar (see Picture 12). The white material coating the fireplace ironwork and chimney brick is efflorescence. Efflorescence is a characteristic sign of water intrusion. As penetrating moisture works its way through mortar around brick, it leaves behind characteristic mineral deposits. The most likely source of moisture is rainwater penetrating into the chimney. Chimneys lack caps to prevent water penetration. Over the course of the building's existence, it appears that rainwater has penetrated into the chimneys and over time, resulted in water damage. Paper and boxes around the chimney and accumulated materials above the fireplace plug can become wet during rainstorms. These materials can absorb moisture and can serve as media for mold growth. Mold grows in cycles, which creates spores, mold fragments and other related problems. These particles can become aerosolized with increased airflow over contaminated materials.

The basement of the town hall has two drainage troughs that run from the front of the building towards the rear along the floor. One floor trough runs into the length of the water department area floor. The second trough's course could not be determined because it is covered by a raised false floor of basement offices that houses the board of health, building department, hallway, restrooms and elder affairs office. While the trough in the water department area was dry, running water was found beneath the false floor of the basement town offices (see Picture 13). The integrity of part of the floor in a closet near the restrooms appeared to be compromised, which may be an indication of water damage in the flooring wood. If the drain to this trough becomes clogged without stopping the source of running water, flooding can result in the basement.

The northeast corner of the basement was reported to have experienced a termite infestation. Beams in this area show signs of holing and wood degradation, which are usually signs of termite infestation. Steps to rid the building of termites were taken. Termite infestation usually begins in moistened wood. Around the corners of the building are rainwater gutters and downspouts. Downspouts are buried (see Picture 14) and reportedly drain through a system in the rear parking lot. It is possible that this drainage system is leaking, resulting in water penetrating into the basement and wetting the beams.

Other Concerns

The heating system in the basement has insulated pipes. In the board of health storage closet (see Picture 15) and the water department (see Picture 16), the ends of this insulation are not encapsulated and appear to consist of white, chalky material. The material may contain asbestos and should be remediated in conformance with all applicable Massachusetts asbestos abatement and hazardous materials disposal laws. The restrooms in the basement have no mechanical ventilation. Restrooms are primary sources of moisture and standing water.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Maximize the amount of fresh air drawn through the fresh air vents. Once the fresh air supply and exhaust systems are functioning, have the system balanced by a ventilation engineer.
2. Consideration should be given to provide higher efficiency air filters for the heat pump in order to reduce dusts.
3. Repair the exhaust vent motor in the attic.
4. Determine the source of running water below the floor of the basement offices and repair.

5. Ascertain whether the pipe wrap in basement contains asbestos and encapsulate or remove in conformance with Massachusetts law.
6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low should be implemented. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations). Consideration should be given to obtaining a vacuum cleaner equipped with a high efficiency arrestance (HEPA) filter to reduce the aerosolization of respirable particulates in the building.
7. Identify if the rainwater downspout system is draining properly to prevent further water damage in the basement.
8. Consider pointing exterior brick.
9. Repair water damaged wood window frames and interior plaster.
10. Seal unused chimneys on the roof to eliminate water penetration. For chimneys still in use, consider installing a chimney cap to prevent rainwater penetration.
11. Remove seal on second floor fireplace and remove accumulated debris. Reseal fireplace.
12. Replace water damaged flooring near the basement closet in the west side of the basement.

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.

Picture 1

Fresh Air Intake Vent

Picture 2

Plastic Grates that Serve as the Return Air Vent

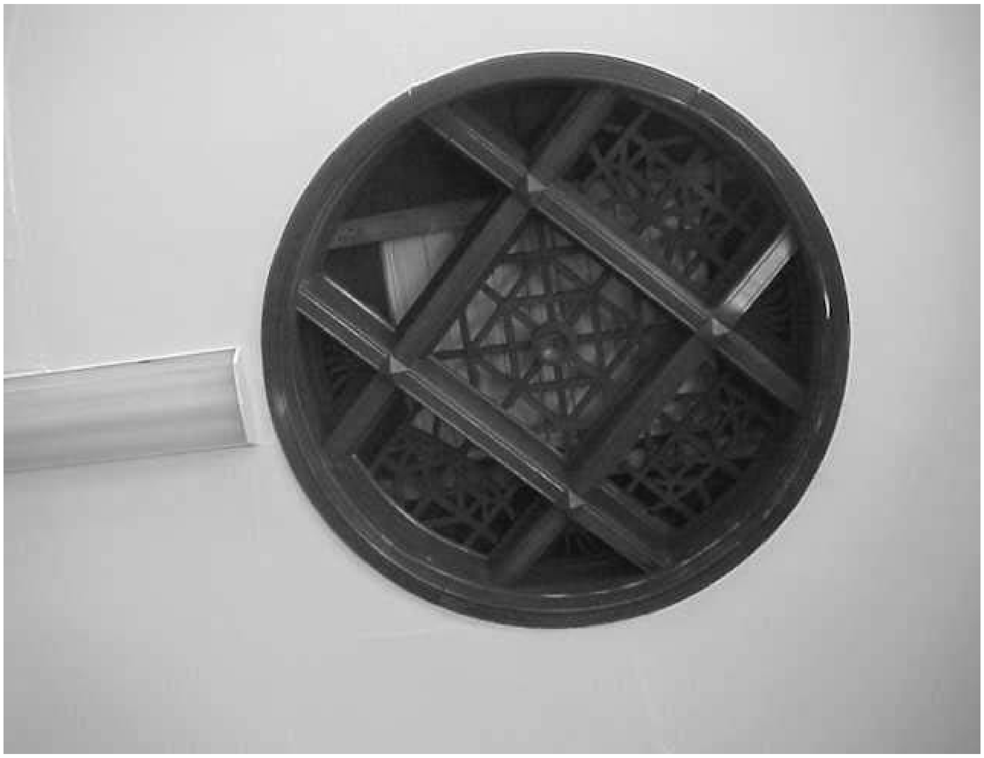
Picture 3

Passive Vent in Auditorium

Picture 4

Trapdoors for Passive Auditorium Vents in Attic

Picture 5



Passive Vent Retrofitted With Fan, Note Missing Light Fixture In Center Of Vent

Picture 6

Auditorium Exhaust Fan in Attic

Picture 7

Water Damaged Plaster in Auditorium

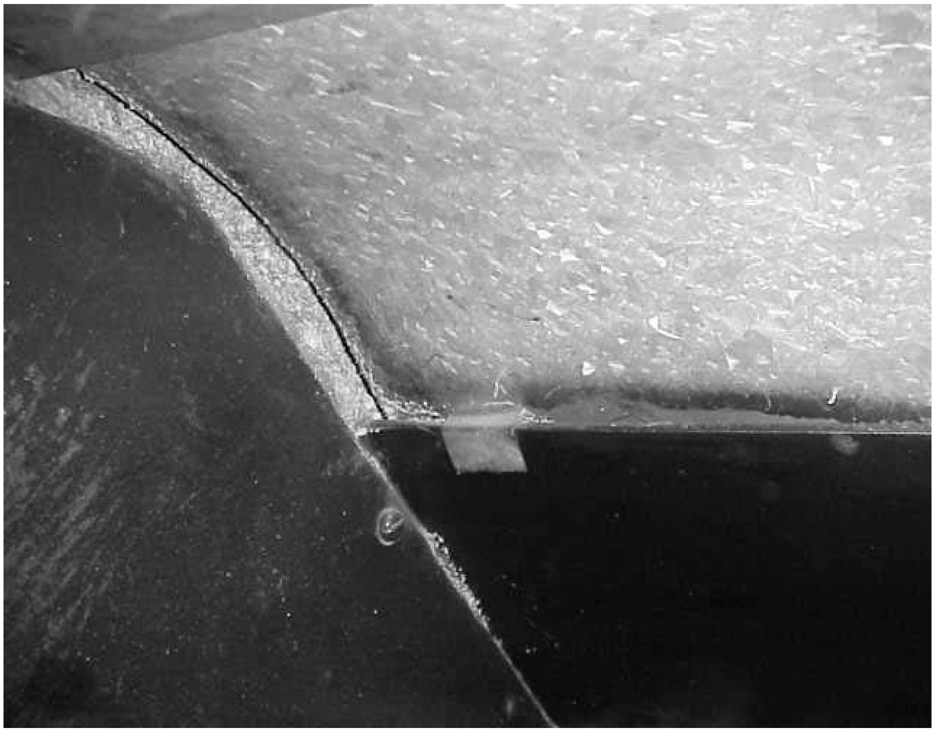
Picture 8

Water Damaged Wood of Window Frame

Picture 9

Damaged Brick Mortar in the South Exterior Wall

Picture 10



Material Used to Seal Chimney in Selectmen's Office

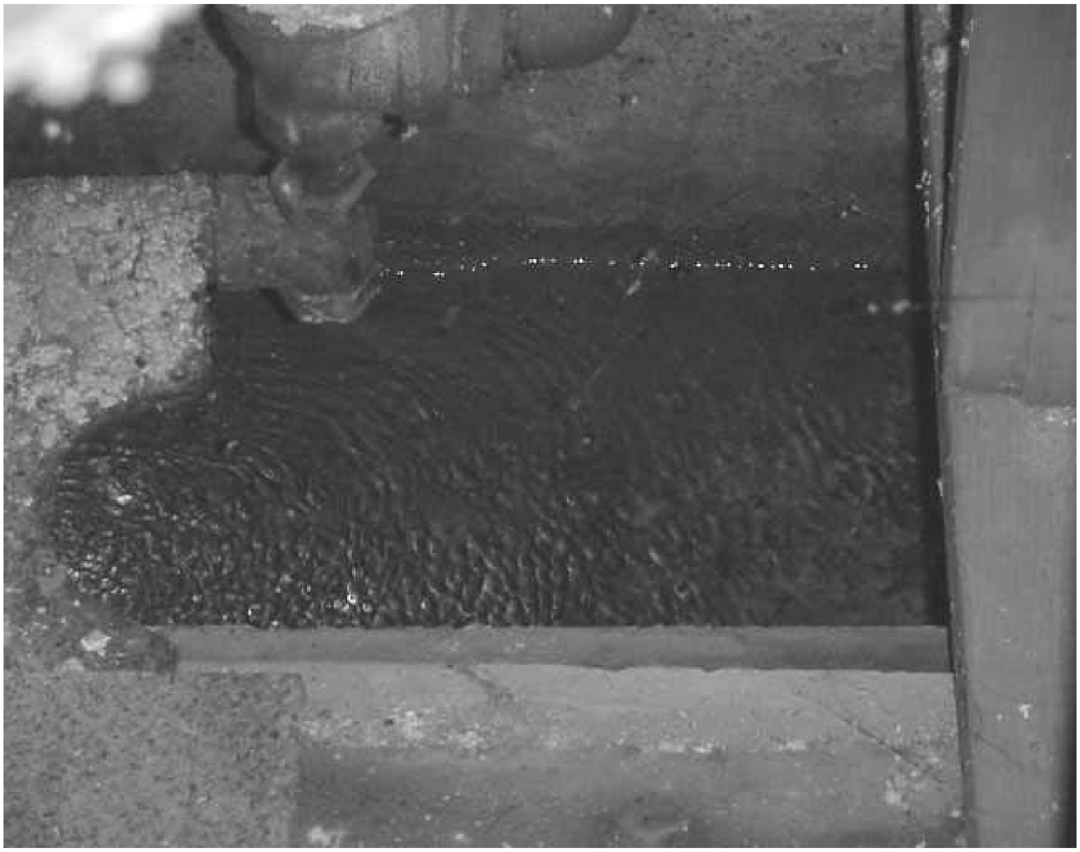
Picture 11

Back Wall of Fireplace in Selectmen's Office, Note White Coating

Picture 12

Powdered Brick and Mortar of Chimney on Attic Floor

Picture 13



Running Water in Floor Trough beneath the Board of Health Office

Picture 14

Underground Downspout at the Northeast Corner of Building

Picture 15

Pipe Insulation in Board of Health Storage Closet

Picture 16

Pipe Insulation Noted in the Water Department Basement Work Area

TABLE 1

Indoor Air Test Results –Hopedale Town Hall, Hopedale, MA – March 30, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
Outside (Background)	449	56	26					
General Office	587	80	13	3	no	yes	no	
Vault Meeting Room	568	80	13	0	no	no	no	
Town Clerk								efflorescence/peeling paint-due to missing mortar
Notary Public	583	75	14	2	yes	no	no	2 CT, water damaged plaster, door open
Board of Selectmen	583	74	15	1	yes	no	no	water damaged chimney (see pictures)
Auditorium	552	71	19	0	yes	no	yes	exhaust off, 3 ceiling tiles ajar
Cable TV Office	545	73	11	1	yes	no	no	
Board of Health	554	76	17	0	no	no	no	
Building Department	576	74	17	1	no	no	no	door open
Water Department	535	69	25	3	no	no	no	termites, possible asbestos containing material

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2

Indoor Air Test Results –Hopedale Town Hall, Hopedale, MA – March 30, 2000

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
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